Vol.VII No.2 February 1978 Monthly except during July and August Price $5.50 yearly Single Issue 75¢

Publisher, Jim Cranshaw

Second-class postage paid at Dallas, Texas Office Address: 9820 Silver Meadow Drive, Dallas, Texas 75217

214-286-1673

THE NEWSPAPER FOR
THE HOBBYIST OF VINTAGE
ELECTRONICS AND SOUND

THE HORN SPEAKER

The Flame Microphone

SOUND WAVES IN AIR ARE TRANSLATED DIRECTLY INTO ELECTRICAL ENERGY THROUGH A FLAME, WITHOUT VIBRATING DIAPHRAGM. IT IS THE RESULT OF PHONOFILM DEVELOPMENT.

By DR. LEE de FOREST

Dr. de Forest and His New Microphone Which He Developed for the Phonofilm. Inside the Box May Be Seen the Burner and Electrodes.

FOLLOWING the cordial public reception given to the invention of the de Forest Phonofilm or talking motion picture which was formally given a demonstration before the members of the New York Electrical Society in the Auditorium of the Engineering Societies Building, Dr. Lee de Forest announces that he has realized the dream long held by telephone engineers, namely, the translating of sound waves in the air directly into electrical currents, thereby eliminating the vibrating diaphragm.

An entirely new form of microphonic device has been evolved by the inventor, in part as a result of his development of the Phonofilm, a speaking flame, if you please, which gives promise of revolutionizing the present methods of transmitting voice sound waves into electrical waves and without the distortion associated with the older methods of voice transmission. The field of immediate application of the talking flame device is not only in the province of the talking motion picture film, but in the world of radio as well, and especially in those stations used for broadcasting the human voice to the millions of radio listeners throughout the country.

DIRECT TRANSFORMATION OF SOUND INTO ELECTRICAL ENERGY

"In response to the numberless inquiries of scientists, educators, engineers and others directly interested in the development of the talking motion picture art," says Dr. de Forest in a statement issued by the de Forest Laboratories, "I should like to take this occasion to announce that as a result of my development of the new Phonofilm my investigations and experiments have resulted in revealing what I consider will be another revolutionary step forward in the transmission of the human voice or sound through space. The advance itself may be regarded as a technical one from the engineering point of view, and yet from the benefits to be derived from the world at large the improvement is somewhat marvelous in that by means of it hereafter we shall be enabled to change voice or sound waves directly into electrical energy.

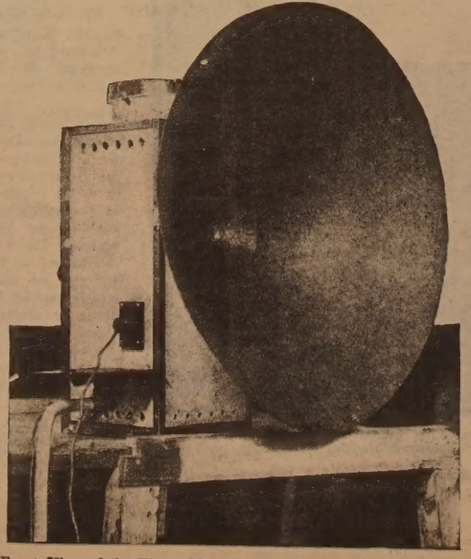
NO DIAPHRAGM USED

"It has for a long time been realized by telephone and acoustic engineers that the necessity for a diaphragm at the transmitter introduces at the very outset of the sound translation problem a source of distortion and imperfection. It is the diaphragm more than any one element which introduces the deformation in recording and in reproducing voice and music on the phonograph as well as in telephone transmission. Therefore for many years efforts of telephone and phonograph engineers have been devoted to reducing as far as possible distortions thus introduced by the natural period of vibration of the diaphragm, or membrane, against which the sound waves impinge. But these engineers have not looked elsewhere in the realm of physics with sufficient scrutiny. Otherwise we should long ago have been free of the necessity for using any diaphragm whatsoever at the transmitter element of apparatus, the object of which is to translate sound into electric currents with the minimum possible distortion, regardless of the expense of the elaborateness of the apparatus thereby involved. I do not here refer to the ordinary microphone transmitter, millions of which are in use throughout the world, and which must necessarily be as simple and cheap as possible. For such telephone apparatus the carbon microphone with diaphragm may possibly always be used.

PROVIDE ACCURATE TRANSLATION

"But where exact and accurate translation of sound waves into electric currents is desired it is quite unnecessary to use a vibrating diaphragm. There are, I have found, a variety of ways of doing this. The discovery of the Audion first came to me as a result of observation of a sensitive gas flame. From this rudimentary idea, which originated in 1900, was developed, during the ensuing five years, the three-electrode vacuum tube which was destined to become the telephone repeater or amplifier for which telephone engineers had been vainly sarching for 20 years. For these were working, always along the well beaten path of a telephone receiver siameesed by some more or less ingenious method to a carbon microphone controlling a local source of electric energy.

"And now in exactly the same way, starting from exactly the same point of investigation, the sensitive gas flame, has been evolved a new form of microphonic device, which does directly what the telephone engineers have so long vainly dreamed of accomplishing, that is, turning sound waves in the air directly into electric currents. Take the ordinary bat-wing gas burner or a certain form of Welsbach mental gas light, or special forms of oxy-acetylene gas flames, insert two heat-resisting electrodes therein, in proper relation to the flame and to each other, connect these electrodes to an appropriate electro-motive force. You will then have an extremely sensitive sound converter which gives an electric reproduction of the sound waves in the air enveloping the flame which is of an entirely different order of fidelity from that ever obtained from any form of microphonic device, using a diaphragm, whether this be of the carbon, electro-magnetic, or electro-static variety.



Front View of the Flame Microphone. Note the Large Horn; This Concentrates the Sound on the Flame.

"Here again history repeats itself. After I had first used the gas flame as a detector of wireless signals I next tried the intensely heated gases in an electric arc and found the same phenomena, although very imperfect on account of the overwhelming loud disturbances due to the arc itself. So again it has been found that a long electric arc in the air possesses the property of modulating to some extent the electric current passing between the electrodes in response to the changes of air pressure produced by the impinging sound waves.

"In Germany an investigator by the name of Vogt has found a similar action in the ionic currents passing through the air between a Nernst glower and cold anode placed nearby. All of these electric reproductions of sound waves are naturally extremely weak, and must be amplified, by means of a series of Audion amplifiers, several thousand times before they can be applied to any useful purpose.

"More recently Dr. Phillip Thomas of Pittsburgh has demonstrated that a high-potential low-current discharge between two electrodes in air may be 'modulated' by sound waves. This is a return to the method which I showed in a patent taken out in 1906 for controlling very simply by the voice the high-frequency, high-potential currents in a radio telephone transmitter.

THE THERMO-MICROPHONE

"But I have found still another method of translating sound waves direct into electric currents without the imposition of any diaphragm. This arrangement, independently suggested to me by Mr. Theodore W. Case, is the reversal of the well-known 'Thermophone,' a device wherein an extremely fine platinum wire, through which is passed telephonic currents, reproduces these in the form of sound waves due to the alternate heating and cooling of the air immediately surrounding the extremely fine wire.

"In my Phonofilm work we have found in the same way that when a series of very fine and very short platinum wires are heated to a dull red from a local source of current the resistance of these wires changes, alternately increasing and decreasing in conformity with the sound waves impinging thereon; so that from a telephone transformer connected in series with the battery and this thermo-microphone, a remarkably faithful representation of the sound waves is obtained, even though the frequency of these be as high as 3000 per second. The sensitiveness of this device is greatly enhanced through a gentle stream of air, by fluid evaporation in the neighborhood, and by other auxiliary means. In a word therefore there now exist several ways of obtaining extraordinarily faithful reproductions of sound waves in the form of electric currents, entirely unlike the diaphragm methods on which telephone engineers have been working from the beginning of their art.

"Part of the sound records used in the Phonofilm have been made by utilizing one or the other of the new converters which I have just been describing. Of all the diaphragm types of transmitters unquestionably the electro-static type as perfected by engineers of the Western Electric Company, comes nearest to approximating perfection. While this is extremely insensitive compared with the best carbon microphonic type, there is no comparison between the fidelity of reproduction by the two means. But one listening in a telephone to the reproduction by means of the flame microphone, and then by means of the electro-

static microphone, will at once exclaim that the fidelity of reproductions in the first case is of quite a different order from that obtained even from the highly perfected diaphragm of the best electro-static microphone."

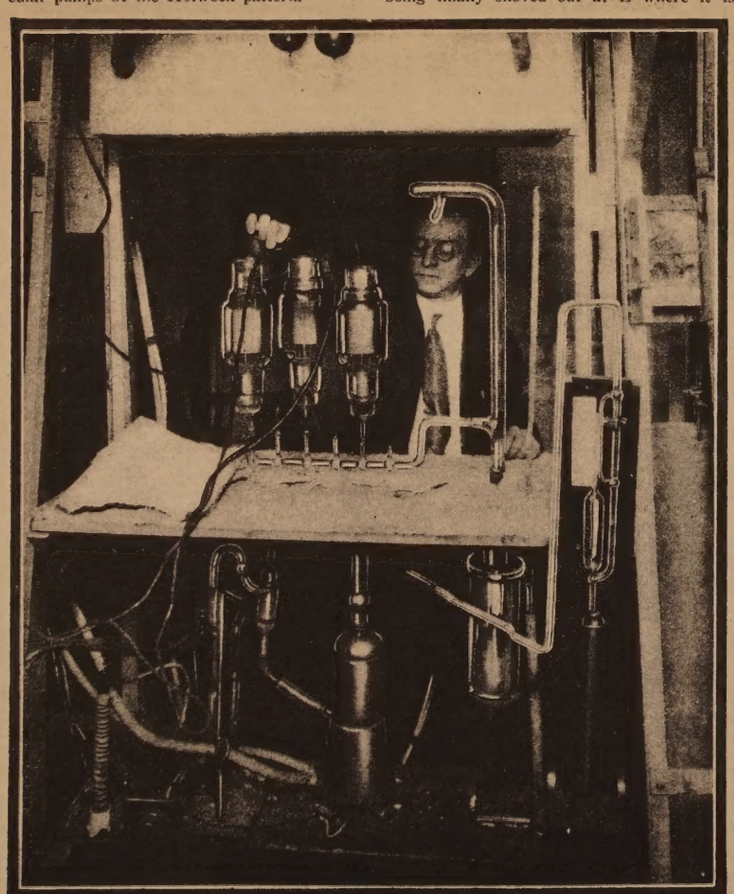
How Radio Tubes Are Evacuated

By DR. C. B. BAZZONI*

This is the second part of an article on the various types of pumps used for obtaining high vacua in radio tubes. The first part of the article appeared in the March issue of RADIO NEWS, *and deals with the simpler types of pumps.*

DISCUSSING, in Part 1, how to evacuate radio bulbs, we classified the various types of air pumps which are used for this purpose and described a method practical for amateurs in such work. We saw that the oil-sealed rotary mechanical pumps are the best now available for steady operation under shop conditions. These pumps, properly handled, can be depended on to give a vacuum of one one-thousandth of a millimeter of mercury, which is roughly one-millionth of the normal atmospheric pressure. Where a better vacuum than this is desired, as in most investigational work, mercury air pumps of the Sprengel pattern may be used. The Sprengel is the type of pump which we described as useful for amateurs on account of its cheapness and efficiency, but is too slow in action for the professional laboratory. The professional research worker must employ pumps belonging in Classes 6, 7 or 8 (See March RADIO NEWS, page 1282) namely, rotary mercury pumps of the Gaede pattern, mercury jet diffusion pumps of the Langmuir pattern, or rotary cylinder molecular pumps of the Holweck pattern.

Gaede's rotary mercury pump is really a high-speed continuously-acting Sprengel pump. It consists of a drum of porcelain or iron, about 8 inches in diameter, of complicated internal construction, arranged to rotate in an enclosing cylinder. Drum and cylinder are somewhat more than half full of mercury. The rate of rotation is about twenty revolutions per minute. Fig. 1A gives a side view of this pump, cut down the middle. Fig. 1B shows how the device operates. It is obvious that the construction of a drum so complicated as the one in this pump represents a triumph in the art of porcelain manufacturing—a triumph for which, naturally, a high price is charged. The air from the receptacle which is being evacuated enters through the inverted goose neck (Fig. 1A) and then passes through the hole H_1, into the chamber C. When the drum as shown rotates counter-clockwise, chamber C (Fig. 1B), increases rapidly in size. When C has passed over to the position shown in the drawing C_1, the hole H_1 is sealed under the mercury and, as the rotation is continued, the contained air is pushed along through the narrow spiral tail, being finally shoved out at E where it is taken away by an auxiliary pump. This action goes on continuously—as soon as one spiral chamber is sealed off beneath the mercury another takes its place due to the rotation.



This illustration shows transmitting tubes being evacuated by means of the Langmuir mercury-vapor pump. *Photo by courtesy of the General Electric Co.*

*Professor of Experimental Physics, University of Pennsylvania.

Fig. 1A represents the actual construction of the drum, but Fig. 1B is a schematic diagram only. A distinct effort of the imagination is required to follow through the action of this pump from an inspection of the figure. When properly understood, however, the action is seen to be essentially like that of the Sprengel pump, although much faster.

It is evident from Fig. 1A that if the pressure in the delivery chamber is higher than that in the inner chamber C by more than the difference of head h (about half an inch of mercury) air will bubble in through the opening and stop the pumping action. This pump therefore requires a "fore pump" or preliminary pump in series with it. The fore pump must be able to keep the pressure in the chamber E below 1 centimeter of mercury. For this purpose a small, motor-driven, rotary oil pump, such as was described last month, can be used. These two pumps in series form a rapid and efficient system. It is possible in this way to produce a vacuum as low as .00001-mm. of mercury. Under the best conditions a five-quart bottle may be evacuated to this degree in fifteen minutes. The evacuated space will, of course, be filled with vapor of mercury, at the pressure (usually about one one-thousandth of a millimeter) corresponding to the temperature, unless means are taken to remove it. The necessary means for removing the mercury will be discussed a little later in this article.

The Gaede mercury pump is historically of great importance: since it was the first rapid-acting high-vacuum pump and since, through its use, physicists were enabled to make a number of important discoveries. Although still used sometimes in laboratories, it has been largely superseded since 1915 by pumps of Class 7—Langmuir mercury jet diffusion pumps—which are cheaper and simpler than Gaede pumps, as well as more effective. One great objection to the Gaede pump lies in the fact that more than forty pounds of mercury are necessary to fill it to the proper level.

THE JET CONDENSATION PUMP

We have referred for descriptive purposes to the Langmuir pattern of pump as a "mercury-jet diffusion pump." However, speaking strictly, Langmuir's pump is best called a "mercury-jet condensation pump," the term "diffusion pump" being reserved for a pump of a somewhat different type which we shall not describe here. Fig. 2 shows the earliest pattern of condensation pump described by Langmuir. The pipe E is to be connected to a fore pump capable of producing a pressure as low as .01-mm., such as one of the motor-driven rotary oil pumps. The vessel which is to be evacuated is attached at R. In the flask A is a small quantity of mercury—less than a pound—which can be heated from below by a gas flame or electrical heater. Under the reduced pressure produced by the fore pump the mercury boils readily, the molecules flying off with very high speeds, because there are few air molecules to interfere with their motions.

As a result of this action a stream of vapor, consisting of high speed mercury

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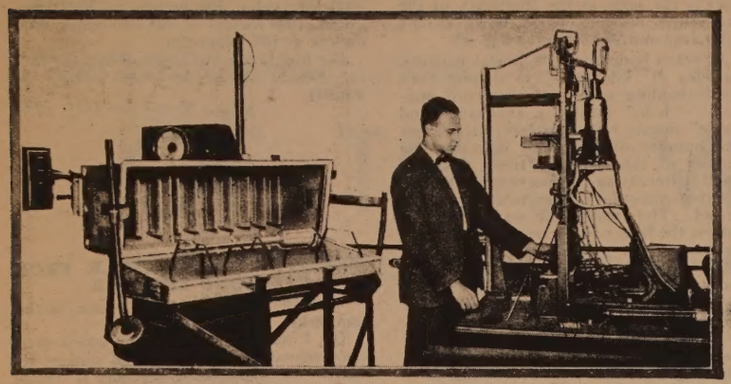

An elaborate vacuum pumping system is maintained by the Bureau of Standards in Washington, for experimenting with radio and other vacuum tubes.

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molecules, is produced upward through the tube B. This stream shoots out into the space C, where much of it is condensed against the water cooled walls. The remainder of the vapor passes up into D and condenses there. The condensed mercury is returned to A through the side drain tubes without loss so that the same mercury is used indefinitely.

MECHANICS OF GASES

In order to understand the action of this pump it must be recalled that the molecules of all gases and vapors are moving about with an irregular, haphazard motion the average speed of which is very high. Since the heat energy of the gas is resident in this motion, the value of the average speed depends on the temperature, but even at ordinary temperatures an average speed of 35 miles per second may be reached. The average distance traversed, before the motion of a molecule is terminated by collision with another molecule, naturally depends on the number of molecules present in the space, that is to say, on the pressure—the lower the pressure the greater the average distance traveled. It is evident that as a result of this irregular motion the molecules in the vessel being evacuated will all, sooner or later, shoot up to and through the opening around the top of tube B. Under ordinary conditions this would not cause the pressure R to become less—since as many molecules would work in through the opening on the average as worked out.

When, however, the mercury jet is in operation filling the tube C with an enormous number of upward moving, heavy, projectile molecules all the gas molecules coming out are swept upward but no molecules (or very few) can work downward. Thus the receptacle R is gradually robbed of its molecules. It is evident from this explanation that, in the long run, every one of the molecules might conceivably be thus removed from R. This type of pump is, therefore, theoretically superior to the types which we have described earlier in this article, for in them the evacuation depends on successive expansions of the air in the container and some air must always be left there as a residue.

The action of the condensation pump is not so entirely mechanical as has been indicated above. The efficiency of the evacuation is connected in some way with the rapidity and completeness of the condensation of the mercury on the walls of the tube. This point is not one into which it is necessary to enter at this point.

Mercury condensation pumps have been made in a great variety of patterns. All are however in essentials like the one shown in Fig. 2. Some are built of metal—welded sheet steel being used for this purpose because iron is not acted on by mercury—but most are made of a special glass. Glass pumps of this type can be bought at prices ranging from $12 to $30. In order to use condensation pumps, a forepump with motor is necessary, as we have already said, costing about $85. The combination, at about $100, gives its possessor a vacuum system of the highest class, capable of producing

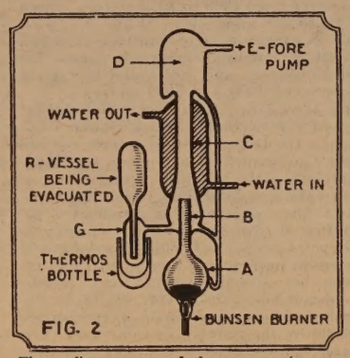

FIG. 2

The earliest pattern of the mercury jet-condensation pump, which was developed by Langmuir.

very rapidly the vacua used in any radio tube on the market. Such a system, properly handled, will produce a vacuum of .000001-mm. For the very highest vacua the art of handling is, of course, not too simple—skill and experience are required.

FREEZING THE MERCURY VAPOR

Since the mercury in this device is hot, it becomes more necessary than before to take steps to get rid of mercury vapor from the evacuated vessel. If this is not done very low pressures cannot be reached. The easiest way to remove the mercury vapor is to freeze it out. This can be accomplished by putting a freezing mixture, contained in a pint thermos flask, on the glass trap G (Fig. 2). If nothing better is available salt and ice (1 part by weight of salt to 2 parts of ice) properly crushed together may be used giving a temperature of 0° Fahrenheit. At this temperature the pressure of the mercury vapor will be .00003-mm., which is low enough for many purposes. The pressure of water vapor at this temperature, however, is nearly a millimeter so that great precaution must be taken to absorb the water vapor, which is always present. This can be done with phosphorous anhydride, a white powder with an intense affinity for water, which can be placed in a bulb attached to the pump or to the vessel being pumped out. In laboratories it is customary to use liquid air in a thermos flask on trap G, instead of salt and ice. The liquid air evaporating in the bottle will produce a temperature of about 300° Fahrenheit, at which the pressures of both mercury vapor and water vapor are so low as to be imperceptible. A vacuum obtained in this way through the use of liquid air is generally called a "liquid-air vacuum"—a term frequently seen in scientific literature.

The mercury vapor condensation pump not only produces very low vacua, but also works very rapidly. Its speed may be as much as twenty times as great as that of the rotating Gaede pump, or even greater under the best conditions of operation. In order to get first-class results in evacuating radio bulbs with such an outfit, the greatest care must be taken to have all connections made tight with sealing wax as described in our last article and also to use heat judiciously on the bulbs and on all the glass parts of the outfit during the pumping down.

MOLECULAR PUMPS

We now come to the description of pumps of Class 8—molecular pumps. These instruments are of great interest, because of the peculiar principle on which they work, and because of their speed, efficiency and cer-

(*Continued on page* 1580)

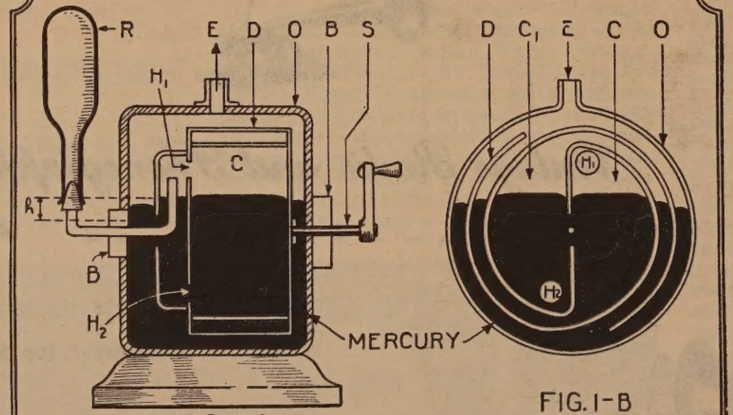

FIG 1-A FIG. 1-B

Above is shown Gaede's Rotary Mercury pump. O is the outer case; D, the drum; R, vessel being evacuated; S, shaft; and B, sealed stuffing boxes. The other letters are explained in the text on the preceding page.

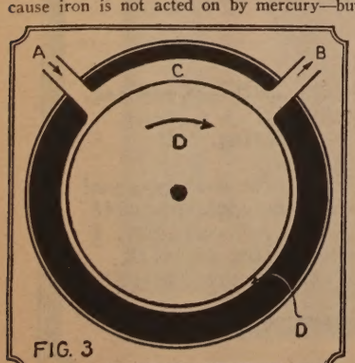

FIG. 3

This sketch illustrates the principles of the Holweck rotary pump. There is a molecular flow from A to B caused by the speed of the rotating drum, D, about 12,000 R.P.M.

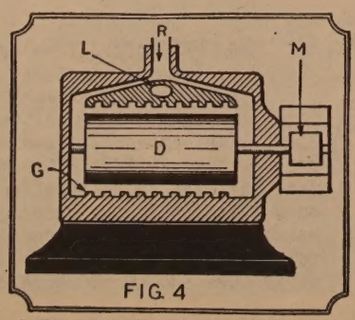

FIG. 4

A diagram (longitudinal section) of the Holweck rotary pump. M is the induction motor, and G, the spiral grooves in the casing, which is less than 1/1000 of an inch from the drum, D.

tain conveniences of use. They are, however, so expensive and difficult to keep in first-class working order that they are of little practical use to amateur experimenters. We have already spoken of the way in which gas molecules fly about at average speeds of many miles per second, and over average paths which are longer as the pressure becomes lower. A molecule of air travels, at a pressure of 1.0-mm., on the average .01-mm. before colliding with another molecule—whereas at a pressure of .01-mm. it travels one entire millimeter without collision. Similarly at a pressure of .001-mm. it travels freely, on the average, ten millimeters and so on. When these molecules strike a stationary wall they bounce off, just as a base ball would from a brick wall. Different molecules coming up from different angles all bounce off in their appropriate directions; so that the motion of the reflected molecules is quite as haphazard as that of the incident ones. If however the surface struck is moving sideways at a high speed a drift in the direction of motion will be imposed on all molecules reflected from the wall and a stream of gas will be thus established in the line of motion of the wall. This is the principle of the molecular pump.

Fig. 3 illustrates this notion. The drum D is rotating in the direction of the arrow at a high speed, say 12,000 R.P.M. The gas molecules coming in at A strike on this drum and a flow is set up toward the opening B through which the reflected molecules finally escape. In order that this action may go on it is necessary that the pressure in the space C be so low that the average travel of the molecules is completely across from the outer wall to the drum. It is also necessary that the crack around from B to A through D should be so narrow that few molecules work through it and thus escape evacuation. Pumps operating on this principle consequently require an excellent forepump—one producing .001-mm. pressure, such a rotating Gaede pump; and also the closest possible machining between drum and case. These requirements render such pumps expensive.

THE HOLWECK PUMP

Although the first molecular pump was made by Gaede the best pattern available today is that of Holweck. The rotating drum of the Holweck pump is a cylinder, smooth on the outside, driven by an induction motor which is inside the pump casing. The vessel being evacuated is attached to the tube at the top, R (Fig. 4) and the molecules travel along spiral grooves cut in the casing from the two ends toward the center where they are thrown out of the tube L to the forepump. The particular pump represented in the sketch has a drum 8 inches long and 6 inches in diameter which is rotated at 4,000 R.P.M. If the forepump produces a vacuum of only one millimeter this pump will bring a five-quart bottle down from a pressure of .01- to .0001-mm. in ten seconds. The clearance between the rotating drum and the ridges of the grooves on the envelope is only about .02-mm. (less than .001-inch)—an example of exceedingly fine mechanical work.

Although the molecular pump can never produce a zero pressure, as is theoretically possible for the mercury condensation pump, nevertheless, in practice, the Holweck pump gives a vacuum as good as or better than the mercury pump, and seems to give it more quickly. In other words the Holweck pump is apparently the fastest and most effective air pump yet produced.

Molecular pumps possess a particular advantage over other types in that molecules of all gases and vapors alike are hurried out through the exhaust. Water and mercury vapor are thus eliminated without the use of freezing mixtures or other accessories. This is a very important feature in some investigational work and is in all cases a great convenience.

LABORATORY HIGH VACUA

We have now completed the description of the various types of vacuum pumps used in laboratories and elsewhere. We have been talking of "the most effective pump yet produced." Let us notice briefly just how close these "most effective pumps" actually come to producing a "perfect vacuum." Some experimenters working with mercury condensation pumps claim to have obtained pressures as low as .0000001-mm. A similar figure has also been claimed for the Holweck pump. Critical judges are however inclined to think that in all probability the lowest pressure reached up to this time is about a millionth of a millimeter. This pressure, which is one one-billionth of normal atmospheric pressure, is very low, yet it is far from a "perfect vacuum." One cubic centimeter of air at ordinary atmospheric pressure contains 10^{19} (about 10,000,000,000,000,000,000) molecules. At a pressure of a millionth of a millimeter, one cubic centimeter still contains 10,000,000,000 molecules. Looked at from this point of view, the famous "high vacuum" does not seem so very high. There is, however, another point of view. The average path over which a molecule travels without colliding with another is, at a pressure of .000001-mm., about 250 feet. It is evident therefore that in a small receptacle evacuated to this degree the individual molecules will act, each one, very much as if entirely alone so that for many applications the space may be thought of as "practically empty."

Earlier in this article it was stated that a radio tube ought to be heated and held on the vacuum pump at least one hour, in order to obtain dependable results. It goes without saying that no such lengthy treatment is given in the commercial preparation of tubes

or of incandescent lamps. A maximum time of evacuation under heating in practice is a quarter of an hour; incandescent lamps are rarely evacuated at a high temperature for more than five minutes and frequently for one minute or less. It is evident that such tubes at the time they are cut loose from the pumps cannot have a vacuum better than .001-mm., and must frequently contain pressures up to 0.1-mm. These pressures are reduced to the average operating pressure of perhaps .00001-mm. by burning out in a test rack, either with or without the aid of certain chemicals introduced into the bulb. Phosphorus, arsenic, sulphur, iodine and their compounds, and powdered metallic thorium and zirconium have all been used in this work. These materials are frequently referred to as "getters." They are introduced into the tubes prior to evacuation and take up the excess gas the first time the lamp is lighted.

The mere burning of a new tungsten filament lamp on the test rack causes the pressure to drop from .001-mm. to .00001-mm. in a half hour, due to a little-understood reaction between the gas ionized in the tube and the material of the filament. The gas is "occluded" or "covered up" largely, apparently, on the walls of the bulb. A similar effect is brought about through use of the "getters," but less time is required, ninety per cent. or more of the gas being removed by the getters in about one minute. These getters leave deposits of characteristic colors on the tubes in which they are used. The shiny, yellowish or brownish coloration of radio tubes is due to this cause. A great deal of study has been put on "getters" in commercial laboratories, since an effective compound of this sort has a high financial value in reducing the expense of tube manufacture. The use of such substances, however, demands a complicated procedure which make them of little value to the amateur experimenter.

The only gas absorbent used generally in experimental laboratories to improve vacua is charcoal. That employed is made from cocoanut shell, since such charcoal is an especially good absorbent for gas. It is cracked into small pieces and introduced into a trap like G (Fig. 2). It is then heated, with the vacuum pumps running, to drive out of it as much gas as possible. On cooling the charcoal will absorb very large amounts of gas and thus improve the vacuum. The effect is, however, not so very marked, unless the temperature of the charcoal is reduced far below normal. The general practice is to surround the trap containing the charcoal with liquid air thus reducing the temperature to — 300° Fahrenheit. At this temperature, and at a pressure of .001-mm. of mercury, one cubic centimeter of charcoal will absorb about 900,000 cubic centimeters of nitrogen measured under the same pressure. Under these conditions the use of charcoal makes an enormous improvement in the vacuum. In fact, by the use of charcoal and liquid air, a first-class vacuum, around .000001-mm., can be produced with relatively inferior pumps.

This information is, however, of little value to amateur workers since liquid air can be purchased only in the large cities, and even there not without difficulty. The amateur who wishes to evacuate radio bulbs is probably best advised to rig up a Sprengel pump of the pattern described in Part I of this article (pages 1282, 1356, March RADIO NEWS). This pump, used with a salt and ice freezing mixture, will give slow but reliable results at very small expense and little trouble.

USE OF KILOCYCLES IN RADIO

The Second National Radio Conference, which met with Secretary Hoover in March, introduced a method of designating radio waves which is somewhat new to the radio public. This is the use of frequency in kilocycles (abbreviated kc) instead of wave-length in meters. The advantages of this practice have been familiar to radio engineers for some time, and it is probable that it will eventually replace the use of wave-length in meters. As a matter of fact, wave-length is a somewhat artificial conception in the handling of radio apparatus and is one of the difficult things for the beginner to understand. The frequency of the radio wave is the same as the frequency of the alternating current which flows in the radio transmitting or receiving set.

As often happens in technical matters, the idea of "kilocycles" is simpler than the forbidding aspect of the word suggests. "Kilo" means a thousand, and "cycle" means one complete alternation. The number of kilocycles indicates the number of thousands of times that the rapidly alternating current repeats its flow in either direction in the antenna in one second. The smaller the wave-length in meters, the larger is the frequency in kilocycles.

The reason that kilocycles are coming into use and displacing meters is that the necessary separation of the frequency of transmitting stations to prevent interference is the same, no matter what the frequency may be. This necessary separation is variable and quite misleading when expressed in meters. Thus the number of radio messages that can be transmitted simultaneously without interference can be correctly judged from the kilocycles but not from the meters. For example, the amateurs will in the future work in a band of wave-lengths from 150 to 200 meters, but this is a frequency band from 2000 to 1500 kilocycles. This is an enormously wider band when considered from the viewpoint of kilocycles than, for example, the band having the same width in meters from 1000 to 1050 meters, which is 300 to 286 kilocycles. While it is possible to carry on fifty simultaneous radio telephone communications between 150 and 200 meters, only one could be carried on between 1000 and 1050 meters.

In accordance with the recommendation of the Second National Radio Conference, the Department of Commerce and other Government departments will hereafter follow the practice of specifying in even values of kilocycles rather than meters. The Conference recommended the practice of expressing wave frequency in kilocycles per second with wave-length in meters in parentheses thereafter. The relation between the two is very simple. To obtain kilocycles, divide 300,000 by the number of meters; to obtain meters, divide 300,000 by the number of kilocycles. For example, 100 meters = approximately 3000 kilocycles, 300 meters = 1000 kilocycles, 1000 meters = 300 kilocycles, 3000 meters = 100 kilocycles.

For highly accurate conversion the factor 299,820 should be used instead of 300,000.

Radio News for July, 1923

REMOVING THE RATTLE FROM A LOUD SPEAKER

R. F. A. Hollowell of Chaison, Michigan, asks:

Q. I have a loud speaker which gives good reproduction on almost all stations received; but occasionally, when one is coming in louder than usual, the loud speaker rattles on some of the notes. This seems to happen only when the music of certain instruments comes in, as when a symphony is being received. Most of the music comes in well, but occasionally there is a rattle, for no particular reason. I am sure that the diaphragm is tight and that everything is solid in the mechanism. Can this be remedied?

A. Your trouble may have several causes. Perhaps an occasional note much louder than the rest strains the speaker beyond its normal capacity for reproduction. Or it may be that an occasional note strikes one of the fundamental frequencies at which the horn vibrates of itself.

In either case it is possible to improve the output by connecting a fixed condenser across the terminals of the speaker in the manner shown in the drawing. The proper size or capacitance of this condenser depends upon the characteristics of the particular horn you use. One of about .006 microfarads should prove right for the average horn. If it does not help, try other sizes until the best results are obtained. It may be necessary to use one as large as .05 microfarads if the horn rattles badly.

Vintage Radio and Phonograph Society

P.O. Box 19406 - - - - - - - - - - - - Dallas, Texas 75219

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Send NAME, ADDRESS, and $5.00 TODAY!

REMEMBER, 1938

OF THIS WEEK

WEEK'S BETTER PROGRAMS

Listen in when Ted Malone features prize-winning poem during program Monday afternoon

BALLOT-STUFFERS —Tuesday, CBS

The technique and practise of election frauds will be given a thorough going-over on the Edward G. Robinson "Big Town" program Tuesday, November 1. "Remote Control" is the title of the special program to be broadcast on that date, and it's a smashing story of a successful fight against fraud and corruption. Steve Wilson, hard-hitting managing editor of The Illustrated Press of Big Town, learns of the machinations of election racketeers when he and his right-hand helper, Lorelei (Claire Trevor) go to the polls and discover that Wilson's housekeeper, Mina, has been tricked out of her right to vote. Swinging into action in characteristic fashion, Wilson goes on a hunt for tangible evidence, finds a grocer who has been duped into letting twelve racketeers use his store for a registration address. But before Steve can get a signed statement from the grocer the latter is slugged and his store wrecked. Illegal registrations, "repeat" voting, intimidation—all these and more come under Steve Wilson's scrutiny as he delves into the workings of the racket, and finally smashes it. Written by Harry Kronman, "Remote Control" will be aired under the expert supervision of "Big Town" producer Clark Andrews, top-ranking Hollywood radio impresario.

8 p.m. Eastern Time; 7 p.m. Central Time. For the West, 9:30 p.m. Mountain Time; 8:30 p.m. Pacific Time

ALLEN FOR ALLEN —Wednesday, NBC

A behind-the-scenes glimpse at radio from the viewpoint of a young man who is really starting in at the bottom will be a feature of "Town Hall Tonight" on Wednesday, November 2, when Fred Allen brings Joe Allen, one of NBC's 150 page-boys, to the microphone as his "Person You Didn't Expect to Meet." Joe Allen worked on Fred's program last year, taking tickets from the studio audience. During rehearsals and at other odd moments, he came to know the comedian as a friend, but he never expected to go on the air with him, and this week's "Town Hall Tonight" will be a highspot in his career. Joe Allen came to Radio City from Belle Haven, N. C. Now twenty-three, he was recently promoted from page-boy to guide, hopes eventually to enter the NBC sales department. Insofar as possible, NBC staffs all its various departments from the ranks of the page-boys. In addition to the two Allens, "Town Hall Tonight" will feature Portland, Harry von Zell, the Mighty Allen Art Players, the Merry Macs Swing Quartet, the Town Hall Singers, Peter Van Steeden and his orchestra.

George V. Denny, Jr., moderator of "Town Meeting"

9 p.m. Eastern Time; 8 p.m. Central Time For the West, 10 p.m. Mountain Time; 9 p.m. Pacific Time

TOWN MEETING —Thursday, NBC

America was established and nurtured to greatness by men and women who were willing to give up their lives for liberty, men and women to whom the basic principle of democracy—open, untrammelled discussion of the truth—was vitally important. Highly placed in American tradition are the "Town Meetings" of old New England, meetings at which vital community problems were thrashed out, with every man's voice just as important as his neighbor's. Time and the mushroom growth of the United States have combined to push the old town-meeting idea out of the picture, and today it's a rare occasion when a citizen can personally speak out for himself in government council. But the idea still survives, and nowhere is it stronger than in "America's Town Meeting of the Air," the NBC program which begins its fourth season of broadcasting on Thursday, November 3, with George V. Denny bringing to the microphone outstanding personalities for free and open discussion of major problems facing the American public. As we go to press, it is learned that this program, formerly scheduled to begin its fourth season of broadcasting on Thursday, November 3, has been postponed until Thursday, November 10.

NO. 1 VOTER —Friday, CBS, NBC, MBS

Like every other American citizen on election day, the President of the United States is privileged to go to the polls and express his choice among the candidates for public office. President Franklin D. Roosevelt votes in the little town of Hyde Park, New York, and in the coming elections he will cast his ballot for a Governor of New York State, for two United States Senators, and for other legislators. On Friday, November 4, a few days before election, the President will address the voters of his home state in a talk that will be of sufficient interest to the country to merit a nationwide broadcast. President Roosevelt is expected to mention in his talk his policy of supporting liberal candidates for office, a policy to which he has adhered in spite of defeats in the recent state primaries.

9:30 p.m. Eastern Time; 8:30 p.m. Central Time
7:30 p.m. Mountain Time; 6:30 p.m. Pacific Time

THREE-STAR OPENING —Friday, CBS

When Miriam Hopkins was a little girl in Bainbridge, Georgia, she sang in a boys' choir at St. John's Episcopal Church because there weren't enough boys to fill out the parts. The incident is typical of Miss Hopkins' career, for it's rarely that she does anything in a commonplace fashion. The Hopkins touch of originality will be exhibited next on Friday, November 4, when she comes to the Hollywood Hotel program to play with William Powell and Charlie Butterworth in "Trouble in Paradise." The starring role in the film of the same name is one of the highspots in Miriam Hopkins' movie career. She came to Hollywood from the New York stage, had been in vaudeville before that, first became interested in dramatic work as a teenage girl in the Goddard Seminary in Vermont.

9 p.m. Eastern Time; 8 p.m. Central Time
7 p.m. Mountain Time; 6 p.m. Pacific Time

The Lane sisters—Rosemary, Priscilla, Lola—and Gale Page, stars of the Warner Brothers picture, "Four Daughters," will do a comedy sketch with Eddie Cantor on his "Camel Caravan" hour, Oct. 31

The MIDGET RECEIVER

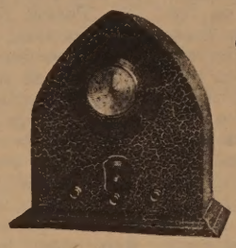
Diamonds are not necessarily shipped in box cars, nor does a radio set have to be housed in a large cabinet to be a thoroughly good receiver. While midget receivers will never replace the console receiver as the major radio installation in the home, they find vast usefulness as an auxiliary installation in numbers of ways. Not only this, but with the mantel set the man who cannot afford a hundred or more dollars for a pretentious receiver can still have a modern receiver of modest size, with proportionate cost

Continued from last month

Atchison Radio Mfg. Co.

Republic Radio Co.

Woodstock Elec. Corp.



Woodstock Elec. Corp.

Crosley Radio Corp.

Transformer Corp. of Amer.

Plymouth Radio Corp.

Davison-Haynes Mfg. Co.

Colonial Radio Mfg. Co.

Gray-Danielson Mfg. Co.

Colin B. Kennedy Corp.

Zaney-Gill Corp.

movement has gone into full swing so that there are now 37 factories in the southwest in actual production of mantel sets and at least four, if not more, nationally known radio organizations have followed suit.

Just what the ultimate result will be of the entrance of national groups into the field is, of course, problematical. Certain it is that the southwestern factories have the momentum of an early start, if that means anything, and a pretty good sized part of the research work done there is evidenced in the sets now actually on the market.

General Design Features

In large measure, the mantel sets are fairly similar in cabinet design, although there are outstanding features to distinguish them apart—curved peaks for some, futuristic designs in others, one or two with a clock inserted in the face of the cabinet. One shop puts out mantels in a dozen different paint jobs to match the furniture, while another has inserted a phonograph turntable in the top and thus makes a creditable miniature radio-phonograph combination set.

In the matter of the technicalities of these small sets there is not a great deal of difference, although every month or so some one manufacturer comes out with a change or two to furnish opportunity for a "new line."

Let's look at an "average" set and see what's in it. Here are the specifications and work sheet for one of the factories: D.C. voltage into filter, 300; d.c. voltage out of filter to –45 plate, 225; d.c. voltage to r.f. plate, 175; d.c. voltage to power detector plate, 50; to –45 grid, 45; to power detector screen, 22 maximum (volume control); to r.f. screen, 100; to r.f. cathodes 1 to 12 (volume control); to power detector cathodes, 1 to 10; 40-volt surge with tubes removed; a.c. voltage with side transformer secondary, 360; a.c. voltage r.f., power detector, –45 filament, 2.2; a.c. voltage –80 filament, 4.9.

The speakers, small sized, are ordinarily full dynamic, especially built to match the receiver—special field winding, 2,400-ohm, and a special voice-coil spider peaked approximately 80 cycles. Rola, Magnavox and Lansing speakers seem to predominate in the western factory make-up.

A.F. couple—resistance couple of special design (not Loftin-White), with 500 volts maximum, designed for flat curve amplification and minimum plate voltage and drain. 300 volts maximum at source.

R.F. system—two stages sharply tuned screen-grid r.f. with coils designed for maximum gain per stage without the necessity of shields, thereby preventing the losses incurred through the use of shields; three-gang condenser.

In this the gain of the r.f. channel is equal to the average receiving set which employs three stages with shields. The interstage coupling is minimized through proper coil design and proper arrangement of coils on the chassis.

Oscillation is obtainable and controllable, thus adding considerably to gain and selectivity with a fairly even distribution of stations at the lower end of the dial.

The volume control is practically perfect, without loss of tone quality at any setting, and there is no absorption or loss in gain at the maximum setting.

It controls the r.f. bias, power detector screen and power detector simultaneously, thereby incurring no overloading of electric strain on any part of the circuit; smooth and positive in operation, not subject to excessive wear and thus necessitating frequent replacement.

In the filter system, the speaker field acts as a choke; condensers, 16 mfd. total. This is of the electro-chemical type and is not subject to corrosion or seepage. The voltage rating is conservative, self-healing in the event of punctures and perfectly sealed from moisture.

The power transformer is conservatively rated, is well insulated, designed for effective cooling, L-shaped core allowing coils to be separated and resulting in better ventilation, mounted on chassis for free air circulation.

So this five-tube set—three screen grids (one is the power detector), a –45 and a –80—can be taken as an "average" mantel type set.

Similarity of Midgets

I think, on the whole, that while the more than thirty factories are getting out the same number of different sets, there is no radical difference to be noted in any of them.

Some of them vary in the number of r.f. stages, some using two and others three. Some use the Loftin-White and some resistance coupling in the audio. Some use two and others three stages of screen grid. A few are using –27's instead of screen grid in the power detector circuit. Some shield while others do not.

There are, of course, various ramifications in attempts either to make the set a trifle different from other makes or in the interests of getting out something actually better.

By far the majority of the cabinets are in walnut or veneer, with a dark, hand-rubbed finish. One manufacturer has just begun to go into production for his multi-colored line in jazzy colors, while another is designing his cabinets in the form of a replica of famous California missions.

The average list price is $59.50, although perhaps a quarter of the factories list at ten dollars higher. There is an additional charge for the carrying cases if needed.

One set is made in the form of a valise with handles on the side.

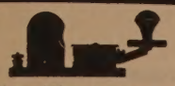
The Los Angeles factories range from small stores with perhaps ten employees and 100 sets a week, to the largest with more than 100 men and 2,000 sets every seven days.

There are, of course, a few backyard manufacturers—that is, men who do ten or a dozen sets a week in their garage at home and peddle the sets direct to the retail trade.

For sundry reasons, perhaps the difficulty and the time lost in locating miniature parts, the small establishment and the home set-builder have not done very much in this field as yet.

So the mantel type movement, starting originally to keep the men busy during dull times, has actually developed an entirely new market. Still in the embryo state, almost any day some new development may take place which might make revolutionary changes in the actual set-up of these small, low-priced receiving sets. The majority of midget set makers are licensed under RCA, Hazeltine and La Tour patents.

50 YEAR OLD FLAME PROOF KEY
TYPE J-7-A
Gov't Order No 141082 Dated 1921



Beautiful heavy duty construction, in new working condition. For the collector, antique buff and antique gear museums. An unusual conversation piece, curio, desk weight and gift.

In 1966 the U.S. Navy closed the hugh Brooklyn Navy Yard and the City of New York purchased the property. The J7A Keys were discovered in a warehouse where they had been stored for the past 50 years.

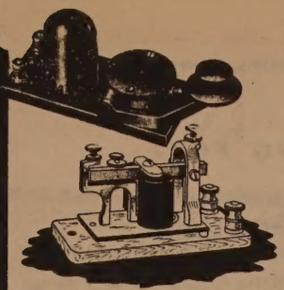
New boxes have been provided.

Both keys are of heavy duty construction with a large Navy type knob. The keying arm and dome are brass . . . the contacts are ¼ inch coin silver. The J7A is 2½ x 5½ inches and the J5A is 2½ x 3¼ inches in size. The BULB, or Lamp is NOT supplied with the J7A.

A RARE FIND! ORDER TODAY **19.95 ppd**

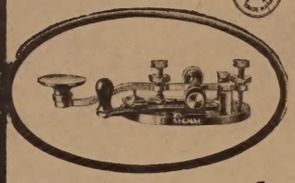
The J5A was made for the Signal Corps in 1941, and is the same type of Key except for the Dome housing the neon bulb. A real memento of WWII. Supply is somewhat limited . . . . buy today!

19.95 ppd



Telegraph sounder.

telegraphic relay.



Send Now!

ALL TELEGRAPH EQUIPMENT IS BECOMING SCARCE!....Sounders in particular!

A early Bunnell catalog says...."These Sounders have aluminum or brass levers, and with one cell of local crowfoot battery will give a loud clear and quick stroke, equal to the best of any other form using two cells". Any of the low voltage solid state power supplies eliminate the need for batteries.
Presently, the stock is real good, and you can choose from 4 or 120 ohm models. Both Bunnell and Western Electric, and a few Signal Electric Sounders are in stock. Checked and Guaranteed.

SOUNDERS $40.00 ea.

THE TELEGRAPH RELAY.....

The Telegraph Relay is an instrument designed to key a separate circuit of any desired current in exact duplication of weak current pulsations required to operate the relay. The Relay is a keying unit only and does not have to function with an audible click. The models in stock at the present time are clean, fine looking instruments. This along with a sounder and key will enhance any Antique Radio and/or Telegraph display.

RELAYS $40.00 ea.

THE TRANSMITTING KEY.....

The KEY consists of a lever equipped with a composition knob, which is mounted on trunnions. Pressure down on the knob closes electrical contacts which are instantly opened by spring action when this pressure is released. Most of the keys in stock are brass base, steel trunnion, and shorting switch. Brass keys are almost a thing of the past.

BRASS TRANSMITTING KEYS $21.00 ea. Army Surplus J38s $12.00

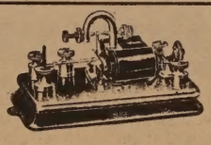
VIBROPLEX BUGS.....

These are the older models and I find them hard to describe. Basically, through the years their models have been the same with a little chrome added here and there. I do know that these older models work better than what you can buy NEW at the present time.

VIBROPLEX BUGS $40.00 ea.

WALTS EMPORIUM

P. O. BOX 19406
DALLAS, TEXAS 75219
EVENINGS – 214-262-7855



SOUNDERS – RELAYS – PONY RELAYS

ALL SOUNDERS, RELAYS, AND PONY RELAYS ARE USED. THEY HAVE BEEN CLEANED, BUT NOT POLISHED. FURTHER CLEANING AND FINISHING MAY BE DESIRED. MONEY BACK GUARANTEE IF NOT SATISFIED.

SIGNAL

Books relative to TELEGRAPH....like, dot-dash

T1 Montillot, L., TELEGRAPHIE Pratique, Traite complet de Telegraphie Electrique Paris, 1898, Printed in French, large size book with 629 pages that are loaded with illustrations You'll love to have in your library...better be able to read French if you want to know the full description $40.00

T2 Meyer, Frederic L., Twentieth Century Manual of RAILWAY and COMMERCIAL TELEGRAPHY, 4th edition, 1902/05, this book is very close to the Telegraph Instructor book by Dodge. Loosness on hinge, some writing on inside cover. $15.00

T3 Field, Henry M., HISTORY of the ATLANTIC TELEGRAPH, 1866, 364 pages, cover worn, two pages in rear of book have been torn and removed (not a part of the text) $20.00

T4 WESTERN UNION TELEGRAPHIC CODE (universal Edition), compiled by International Cable Directory Company, 1900, 801 pages, book is in excellent condition, $25.00

T5 Official Diagrams of the POSTAL TELEGRAPH-CABLE COMPANY'S APPARATUS and rules governing the construction and repair of lines. published by "TELEGRAPH AGE", 1906, 134 pages, many illustrations, ex lib. $35.00

T6 Pegot, J., La TELEGRAPHIE DUPLEX Theory and Pratique, French print, 1892, $15.00

T7 Twentieth Century Manual of RAILWAY COMMERCIAL and WIRELESS TELEGRAPHY, Meyer, Frederic L., 1914, 7th edition, a later issue of "T2" above, $15.00

T8 La Poste, le Telegraphe et le Telephone., Paris, also written Frency, late 1800's, $15.00

T9 American BANKERS and BROKERS Telegraphic Code, 1910, four copies, all alike, well used, you can have all four for $10.

T10 Frederic, Wilson, TELEGRAPHY and HOW TO LEARN IT, brief chapters on elementary science, 1901, well worn, looseness on cover, but contents in good shape, $15.00

T11 Jones, Willis H., Pocket Edition of DIAGRAMS AND COMPLETE INFORMATION FOR TELEGRAPH ENGINEERS AND STUDENTS, 1915, 461 pages of loaded information and illustrations, $15.00

T12 Crehore, Albert Cushing, Synchronous and other Multiple TELEGRAPHS, some methods of obtaining independent Telegraph circuits on a single wire, both with and without Synchronism, 124 pages in excellent condition $15.00

T13 Edison, Theo A., TELEGRAPHY SELF-TAUGHT, 1902, A complete manual containing lessons on telegraphy in all its branches. $20.00

T14 Brady, Jasper Ewing., TALES OF THE TELEGRAPH, 1899, this is Brady's tales of his life as a telegrapher which included commercial and USA Army. Every chapter in very interesting, and I feel that you will enjoy it as I did....$15.00

T15 Abernethy, J. P., The Modern Service of Commercial and Railway TELEGRAPHY in theory and practice, including the Railway Station and Express Service, 1904, ex lib., 424p. $15.00

DURING THIS FIVE MONTHS, MANY TITLES HAVE BEEN SOLD. A LIST OF THE SOLD ITEMS, TO DATE, ARE LISTED BELOW.

THANK YOU VERY MUCH!

SEPTEMBER 1977

M2	M45	B4	B29	5	56	83	89	98
M11	M46	B15	B31	27	63	84	91	106
M12	M66	B17	B35	29	66	86	93	110
M26	M104	B21	B36	30	82	87	97	112
M43	B2	B26	B40	53	83	88	98	116

OCTOBER 1977

ARRL	1938	1940	CB23	C8-34	C8-38	C8-47	C8-81
1929	1939	1959	C8-29	Home	C8-39	C8-48	
1936	10	CB11	C8-30	C8-36	C8-40	C8-50	
1937	ALLIED	CB15	C8-32	C8-37	C8-42	C8-63	

NOVEMBER 1977

127	C8-86	Nov 5-	C8-91	C8-112
134	June 27	19-26	C8-102	C8-114
140	July 11	C8-89	C8-111	

DECEMBER 1977

13	85	144	Telephone..All T1 thru T17
24	109	T18	"TELEPHONY", 6 issues, 1914
53	127		4 issues, 1915

JANUARY 1978

2-78	5-78	10-78	16-78	3 issues of "Wireless
3-78	7-78	13-78	17-78	Tele....."
4-78	9-78	14-78		

ALL OTHER ITEMS ARE STILL FOR SALE AT THE PRICES ADVERTISED. SOME REAL CHOICE TITLES, ORDER TODAY!

ABOUT 1920 AD

JOHN CHARLES THOMAS, famous baritone, using the Graduola while playing one of his own records. Mr. Thomas records exclusively for the Aeolian-Vocalion.

MR. THOMAS says: "The Graduola makes the phonograph a real musical instrument for personal expression, instead of merely a reproducing machine."

The AEOLIAN VOCALION

The Phonograph That Gives YOU a Voice

HOW often have you listened to a beautiful voice and wished Nature had endowed you with one? Heard some wonderful tenor sing a tender, old-time ballad, or some famous baritone sing one of the ever-popular operatic arias, and longed for the ability to express *your* musical feeling in the same way?

Your wish is now practically granted! Your longing in the way of being satisfied!

The Aeolian-Vocalion will give you a voice to express yourself with—any kind of voice you like—tenor, baritone or bass, even soprano or contralto, singing any kind of music that you like, from great, majestic cathedral anthems to the light, breezy songs of the day.

And it will be *your* voice because it does *your* bidding—sings now softly and tenderly, now strongly and bravely, just as you feel the music, and wish it to.

The Marvelous Graduola

THE AEOLIAN-VOCALION, the superb phonograph made by the world's foremost builders of musical instruments, has a feature that no other phonograph possesses—the famous Graduola.

This feature controls phonograph tone—controls it so perfectly, so simply, so artistically that its effects seem part of the record itself. Only that they are ever changing, inspired, spontaneous and *yours*.

Seated beside the Vocalion with the Graduola in your hands, you are a master of music, with all the world's vocal and instrumental performances at your command. You need no skill, no arduous practice, for using the Graduola is as easy as controlling the modulations of your own voice.

With this marvelous feature added to the unequalled beauty and richness of its tone and fineness of appearance, is it any wonder that the Aeolian-Vocalion has achieved pre-eminence in all the music markets of the world?

THE AEOLIAN COMPANY · AEOLIAN HALL · NEW YORK CITY

LONDON PARIS MADRID MELBOURNE SYDNEY

Foremost Manufacturers of Musical Instruments in the World

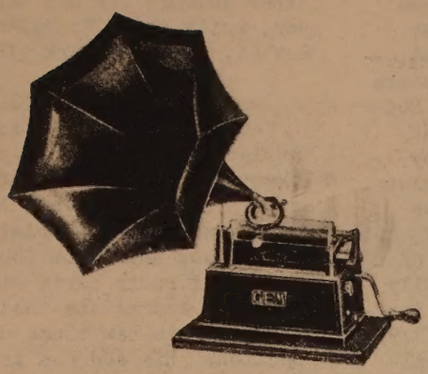
Aeolian Company, 29 W. 42d St., New York City
Gentlemen: Kindly send me your illustrated Vocalion catalog.

Name_____

Address_____

1-15

Makers of the Duo-Art Piano



Edison Gem Phonograph, Latest Model

Price (machine, horn and crane without records) **$12.50**

Price (machine with one dozen Edison records) **$16.70**

The GEM is the cheapest genuine Edison Phonograph made, and by far the best talking machine at the price on the market. Not suitable for making of records. Results not quite as loud as on other Edison machines.

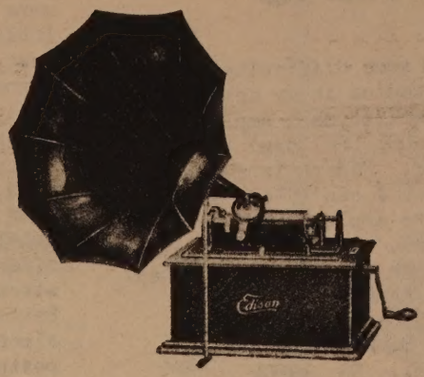
The finish is black enamel with gilt decorations, and the mandrel is nickeled and polished. Height, 8 inches. Base, 10 x 8 inches. *Equipment*—Model C reproducer, horn support, 19-inch polygonal shaped horn, winding crank, carrying cover, oil and oil can.

EDISON OUTFIT No. 1—Includes Edison Gem Machine equipped complete as above, together with your choice of one dozen Edison moulded records. (Records at $4.20 a dozen.)

Price of Outfit No. 1, $16.70, the lowest possible price for spot cash or otherwise on this outfit anywhere.

Shipped on free trial; no money down. Payable if satisfactory after free trial either $16.70 in full settlement, or, if you prefer, $4.70 as a first payment, balance of $12 in six payments of $2 a month. No interest charged on payments.

While this outfit is not as desirable as our larger ones, we offer it for those who wish to expend only a small amount of money, but who insist upon **a genuine Edison**. All kinds of talking machines are now offered at $18 to $24, and similar prices, and not a single one of these machines *begins* to approach the quality of the Edison Gem Outfit No. 1, at $16.70. If you want a phonograph at a very moderate price get the Edison Gem and not some inferior imitation. Remember, please, that the Edison Gem, being a genuine Edison product, is by no means a cheap or inferior affair, but really a high grade instrument; small, but good and serviceable throughout, not our best yet giving very good musical results.



Edison Standard Phonograph, Latest Model

Price (machine, horn and crane without records) **$25.00**

Price (machine with one dozen Edison records) **$29.20**

Made of iron, steel and brass. Its mandrel is nickeled and polished and its finish is black enamel and gilt. Cabinet and carrying cover of antique oak. Body box has a hinged cover, to which the entire phonograph mechanism is firmly fastened, and which may be turned back permitting convenient inspection of the motor. Height, 11 1/8 inches. Base, 13 1/4 x 9 3/4 inches. *Equipment*—Model C Reproducer, oil and oil can, winding crank, oak carrying case, horn support and 30-inch polygonal shaped horn.

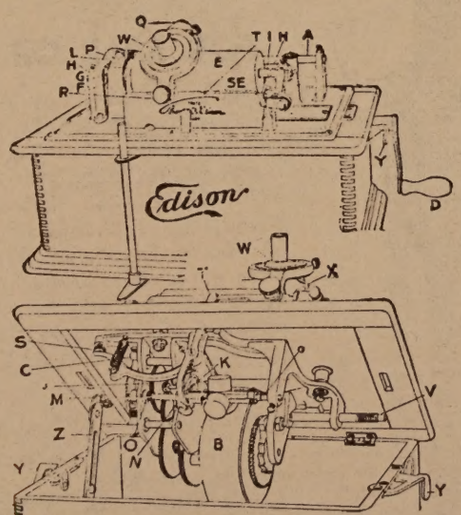
EDISON OUTFIT No. 2—Includes Edison Standard Phonograph as equipped above and your choice of one dozen genuine Edison moulded records.

Price $29.20; the lowest possible price for spot cash or otherwise on this outfit anywhere.

Shipped on free trial; no money down. Payable if satisfactory after free trial either $29.20 in full settlement, or, if you prefer, $6.45 as first payment, balance of $22.75 in seven payments of $3.25 a month. No interest charged on payments.

This Edison outfit No. 2 is far better than the Edison Gem, the cabinet being larger and more handsome, the horn larger, the quality of sound consequently improved. The motor is larger than on the Gem and will play two and more records at one winding. For the price charged this is unquestionably the finest phonograph in the world. Of course, we have other Edison machines at a higher price which are better, but the No. 2 machine is the peer of all instruments at the figure for which it is sold.

1899 Chicago Talking Machine Catalog



Index of Parts

A. Back Rod.
B. Barrel.
C. Belt Tightening Pulley.
D. Crank.
E. Cylinder.
F. Cylinder Gear.
G. Cylinder Gear Set Screw.
H. Cylinder Shaft Centers.
I. Feed Screw Center.
J. Fourth Gear.
K. Friction Felt.
L. Gear Guard.
M. Governor Pinion.
N. Governor Disc.
O. Governor Shaft Pivot Bearings.
P. Intermediate Gear.
Q. Reproducer Arm.
R. Reproducer Arm Lift Pin.
S. Speed Adjusting Screw.
SE. Straight Edge.
T. Starting Lever.
V. Winding Shaft.
W. Reproducer
X. Reproducer Weight.
Y. Catch Lever.
Z. Supporting Link.

How to Operate

See diagram on page 2 for explanation of following:

Place Record on taper cylinder (E) (title end to right); push it on as far as it will go with a slight pressure. Next start motor by pushing starting lever (T) to the left as far as it will go; slide reproducer arm (Q) to the point where the Record seems to begin and let reproducer down by pulling button (R); this engages feed nut (which is attached to back of reproducer arm) with thread of feed screw and also brings the sapphire point of reproducer (W) in contact with surface of Record. When reproducer has travelled to the end of the Record, raise up reproducer arm and stop machine by pushing the starting Record, lever (T), to the right (unless you have an automatic stop); next slide reproducer arm (Q) to about the center of the cylinder and with three fingers of the left hand loosen the Record from the cylinder by pushing it toward the right, and pushing on the edge of the Record with the left hand take off Record with right hand. To play another Record, repeat the above operations.

Adjustment of Speed

All master Records, from which the Edison Gold Moulded Records are made, are recorded at a speed of 160 revolutions per minute, and to reproduce these Records perfectly, it is absolutely necessary that the Phonograph should run at the same speed (160 revolutions per minute), no more, no less.

Every Phonograph is adjusted to run 160 revolutions per minute, but if by accident or through carelessness the governor should become displaced on pinion shaft or the speed adjusting screw (S) underneath the top plate should be turned (whereby the speed would be altered after machine leaves the factory) readjustment of speed can be made by raising up top board and by taking hold of speed adjusting screw (S) between thumb and forefinger and turning to the left to make cylinder run faster and to the right to make cylinder run slower.

There are two circular rings on right side of back rod (A) one and six-tenths inch apart. With the Phonograph fully wound and running at full speed, and with reproducer arm down as for reproducing, the reproducer arm should travel from one mark to the other in exactly 2 minutes, which indicates that the cylinder makes 160 revolutions in one minute.

General Information

Sometimes the machine may repeat or tremble. This may be caused by the Record being loose on the cylinder, in which case a light push at the end of the Record will fasten it. Or the reproducer weight may be caught; in this case raise reproducer arm (Q) and drop it again gently. This also happens when the machine is set on a table or other surface that is not level, which allows the reproducer weight to lean toward the lower side. If the machine should not run freely, apply a drop of oil to centers (H) of cylinder shaft and feed screw centers (I). Back rod (A) and straight edge (SE) should also be cleaned and oiled; also look at belt, as it may have run on the flange of the pulley, which would retard the motion. After a time the belt may become too long, so that the reach of the idler cannot keep it at proper tension; then a new belt is required.

If gears become noisy, put a few drops of oil on the teeth

Above all, keep the machine clean, as the mechanism will not work properly unless free from grit.

Do not leave the Record upon the cylinder (E) of the Phonograph for any length of time when the machine is not in use.

LETTERS

Dear Jim:

I am having some difficulty in restoring two radios in my collection: Radiola Superheterodyne & Amplex model A with 6-401 (Kellogg) tubes & a B-H rectifier. Riders is sketchy on the Radiola & I can't locate a schematic on the Amplex. Any advice, written material, experience, or suggestions would be greatly appreciated.

Thanks,
Mel Rosenthal
507 S. Maryland Ave.
Wilm., DE 19804

EDITOR - For the Radiola the RCA manuals are good. The Wilmington Public Library should have a set of them. I'd try Vintage Radio, Puett Electronics, Supreme, Hanson, etc, for a schematic to the Amplex.

We had an interesting communication from M. N. Beitman who has been involved for forty years in preparing and issuing diagram manuals and service material. He rightly states that at present many factories take steps to include service material right with the new television or radio set and, in many cases, the owner actually is able to produce this material when needed. Such material on recent sets also can be obtained directly from factories, but there is usually a delay beyound a reasonable period and at times one receives a request for advance payment instead of the required material. You may also find what you need at your local library which may have Sams' Photofacts, but more likely they will have Supreme Publications' manuals which cover just "most-often-needed" material. A good source for antique radios are early Supreme or Rider volumes. Duplicating machines are now at most libraries, so you can have a copy even if the manuals do not circulate. Sams and Supreme data can also be obtained from parts distributors, but often just what you need is out of stock. Life is like that. Finally Beitman says, "I'll supply data for almost any radio or TV set for $2.95, postpaid. This will be the actual printed material not photostats and I promise prompt service." So if other sources are not the best for you, write to M. N. Beitman, P.O. Box 46, Highland Park IL 60035.

THUMB NUTS

Keith Parry is now producing a knurled brass thumb nut that looks like it came right off of an old battery radio. The nut has the curves and the appropriate ridges to make you think you found it in an old box of radio parts right from 1925. We appreciate that Keith sent us one of his new thumb nut for inspection. His address is available from his ad.

Incidently, Ray Harland produces both nickel plated brass machine screws and thumb screws. His address is also available from his ad.

BACK ISSUES

The Horn Speaker

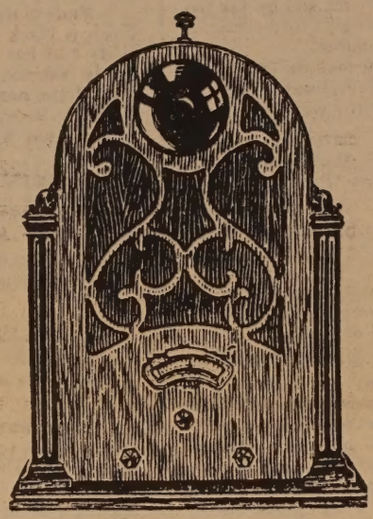
All 10 back issues for 1973...$8.00
Single issues...$1.00 each
All 10 back issues for 1974...$6.00
Single issues...$.75 each
All 10 back issues for 1975...$5.00
Single issues...$.75 each
All 10 back issues for 1976...$5.00
Single issue...$.75 each
Any single issue of 1977...$.75 each
Later, we should have complete volumes for 1972, first year.

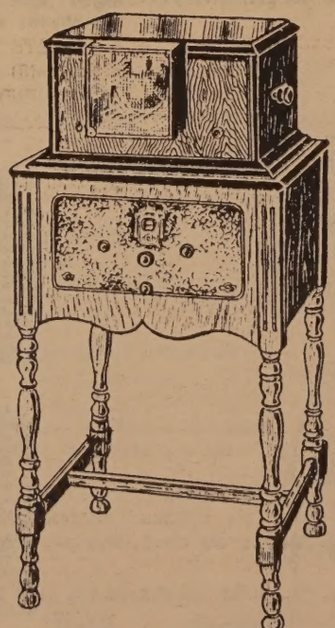
The Horn Speaker

Box 12 Kleberg, Texas 75145

Rates for THE HORN SPEAKER
One year.....$5.50
Two years.....9.00
Special rates for one year (mailed in envelope)
First class.....$8.50
Air mail.....$12.00
Foreign air mail...16.00
Mail address: THE HORN SPEAKER
Box 12
Kleberg TX 75145

WANTED





WANTED: Circa 1928-32 Television; Pioneer television scanner, I.C.A. Visionette, The Western Television Receiver, Baird Televisor, "See All" Television Receiver and scanner kit, Scanning discs, Daven television amplifiers, Taytheon Kino lamps. Any and all information welcomed. Darcy Brownrigg, Chelsea, Quebec, JOX 1NO CANADA

MART

Classified ad rate: 6¢ per word.
Photo ads: $2.00 extra.

Deadline: 20th of the preceding month.

MISC.

"RADIO AGE," a radio magazine devoted to wireless and early broadcast eras. Contains interesting articles written by collectors, articles published in early radio magazines, lots of reprints of famous radio ads, and a classified section for buying or selling radio and electronic items. Subscribe at $7.50 per year for ten issues. Mail check or money order to Radio Age, 1220 Meigs Street, Augusta, Georgia 30904.

FOR SALE OR TRADE

TUBES brand new, not surplus! These popular oldies are factory guaranteed for one year. 01A $7.95 6A7 $3.80, 6A8M $2.95, 6D6/78 $2.95, 6F6 $4.20, 6K7GT $2.95, 24A $4.50, 26 $4.95, 27 $4.50, 35/51 $4.50, 45 $5.95, 58 $3.30, 80 $2.98, 84 $2.00.
Sale expires 5/1/78. Add $2.00 per order postage and handling. FREE catalog of over 1,000 tube types. Connolly, P.O. Box 1333H, Sun Valley CA 91352.

RIDERS RADIO MASTER INDEXES: Vols. 1 to 15 $12.50; Vols. 1 to 23 $15.00; Vols. 1 to 20 $14.00; EARLY RIDERS Vol. 1 1919-1927 covers all battery sets, 200 pages, $17.50.
RADIOLA BATTERY SET SERVICE MANUAL 1922-1927 covers all battery sets 85 pictures & diagrams $5.00.
RIDERS Vol. 1 in 16 parts $5.00 each, 50 to 70 pages each, order by manufacturer parts 2 and 11 covers AK & RCA other parts cover 2 or more manufacturers.
NEW STYLE WD11 bases $6.00 per pair. Send SASE to K. Hanson, 3403 Broadway, Long Beach CA 90803.

FOR SALE OR TRADE

ZENITH Table, 5-R-312, automatic tuning, complete. Tubes OK, not working. $4.00.
ZENITH Portable, 6G601ML, suitcase style, complete. Not working, both 1940, $4.00.
STROMBERG-CARLSON 1935 table 325-H, tubes OK, automatic tuning, needs work $7.00.
EMERSON table BF-207, 1938, not working. Cabinet has crack $4.00.
RCA-VICTOR portable, 1940, 9BP1, working condition $3.00.
ADMIRAL portable 1950, 4B22, tubes OK, not working $2.00.
SYLVANIA clock radio, 1950, A-2109, tubes & clock work, radio doesn't $4.00. All prices plus shipping.
L. Balsys, 33 Phoenix Ave, Naugatuck CT 06770.

FOR SALE OR TRADE: Want to specialize in Horn Phonograph collecting. Will sell or trade the following radios as found. Atwater Kent Bread Board in original box. More AKs. DeForist, Silver Marshel, Grebes, Federal and RCAs. More battery sets. Cathederals, Peter Pan, AK, Majestic, Zenith, Philco and others. Many AC table models 1930s. Several 1940s televisions. Other electronical antiques. Please call 503 476-1078.
Charlse Seidel, 925 Starlite Pl., Grants Pass OR 97526.

FOR SALE: 6k6, 6N7, 6J5, 6U7 and other used tubes 50¢ each. Clock timers 2 for $1.00. Assorted rotary switches 10 for $1.00. Phonograph motors 3 for $5.70. Phonograph tone arms 6 for $2.70. Phonograph amplifiers 3 for $5.70. Have used parts for majestic model 70-B. Motorola Model 82A. Wells-Gardner model 1A29 AC radios.
Elmer Nelson, 824 So. Pleasant St., Princeton IL 61356.

HAVE ANTIQUE RADIO & TV TUBES. Also some antique & old radios. Send 26¢ stamps for list w/prices.
Harold's Radio, 3106 N. 3rd St., Harrisburg PA 17110.

FOR SALE: Old battery and AC radios, speakers, phones, parts and tubes. SASE for lists.
Franklin Haas, 207 West 30th., Hutchinson KS 67501.

TRADE: Have nice Mini Phono (Camera-phone) less turn table. Want interesting battery radio or Telmegaphone speaker.
George Hausske, 1922 E. Indiana, Wheaton IL 60187.

FOR SALE: Selling Rider's single volumes, complete sets, also early Sams', Supreme, old factory manuals.
Beitman, Box 46, Highland Park IL 60035.

SEND SASE For list of battery radios, literature for sale. N. Hertz, 186 Kensington St., Brooklyn N. Y. 11235.

FOR SALE OR TRADE

FOR SALE: OLD STYLE CLOTH COVERED WIRE: 18-guage AC line cord in Gold or Brown, 20¢/ft, or 16¢/ft. for 100' or more. Add $1. shipping.
NEW CRYSTAL SET PARTS: Mounted detector assembly with crystal - $1.50. Crystal holder + arm + whisker 85¢. Tested Galena crystal 65¢. Cat's whiskers 2/50¢. Nickel-plated fahenstock clips 10/80¢. Nickel-plated brass phone tips 10/75¢. Add 50¢ shipping.
AUTHENTIC HORN SPEAKER CORDS: 4 1/2' or 6' long, black color, $3. each. Add $1. shipping per order. SASE for more info + wire samples.
Robert Goodman, 7943 Ponce Ave., Canoga Park CA 91304.

FOR SALE: RCA Radiola IV, Westinghouse RA-DA, Steinite labs Crystal set, Grebe Syncrophase MU-1, Hallicrafters T-54 TV, Pilot 3" TV, Edison Home Phono, Pathe Grand (horn) Disc Phono. SASE for information. Richard Cane, 8391 N.W. 21st. St., Sunrise FL 33322.

WD11 and UV99 adaptors. Use any UX base tube $5.50 ea. PP. U.S.A, 2 for $10.00 either type.
4K brass thumb nuts as used on Breadboards and Mod. 20 sets, 10 for $8.00 PP. K. Parry, 17557 Horace St., Granada Hills CA 91344.

BLANK BAKELITE PANELS - Cut to size, 1/16" to 3/8" thick. Fabricating and engraving services available. SASE for pricing sheet.
Parsons, WB1BVO, 22 Forest St., Branford CT 06405.

SASE FOR LIST OF DUPLICATE EARLY RADIO MAGAZINES, BOOKS AND PARTS, NEED SCHEMATIC OF FRONT END OF CROSLEY MODEL XJ EARLY MODEL WITH VARIABLE ANTENNA COUPLING CIRCUIT. HAVE SCHEMATIC OF LATER MODELS.
W6ME, 4178 Chasin St., Oceanside CA 92054.

25 issues of Electricians & Mechanics 1909-1912, good to mint condition $135.00 or TRADE.
Guy Martin, Box A, Azusa CA 91702.

FOR SALE: Send large SASE for list of radio magazines, catalogs, tubes, parts and etc. to: G. B. Schneider, 6848 Commonwealth Blvd., Parma Hgts., Ohio 44130.

FOR SALE: 5 tube Freshman Masterpiece as pictured on front page of January 1978 HORN SPEAKER, $50.00 plus shipping. Daniel Gaidosz, 342 West River Road, Orange CT 06477.

FOR SALE: Riders radio manuals 1-16 inc. No indexes, $160.00.
J. Allen Call, 1876 E. 2990 So., Salt Lake City UT 84106.

TRADE: New Nikkormat and Olympus cameras for antique radio and wireless gear. Paul Giganti, 2429 San Carlos Ave., San Carlos CA 94070. Phone: 415 593-4723.

WANTED

CATHEDRAL RADIOS: Will buy 1 or 100 working or not. Also large Zenith table sets and consoles. Will trade sets. Nate Alexander, 2563 N. Farwell Ave., #12, Milwaukee WI 53211. Phone 414 964-7043.

I found an OZARKA wooden table model case, I need the insides; no model number or anything on the case, it could either be AC or DC. The case has decorations on ends a rosette 4 inchesor so big. 24 in. long, 12 wide and 10 high, has a lid. Three openings in the front all on one escutcheon.
Joe Tompkins, 3796 Hulsey Ave. SE, Salem OR 97302. Phone 362 8071.

WANTED: CIRCA 1930-31 TV scanning discs, Daven video amplifier, Kino lamps, complete and Partial kits. Also all manner advertising material on receivers by Jenkins, Baird, others.
Darcy Brownrigg, Chelsea, Quebec JOX 1NO Canada.

WANTED: Large lot external horn phonographs, parts, cylinder records, crystal sets, battery radios factory mfg., before 1926. Will pay $75. for mint Lambert Jr. Crystal set.
Young, 11 Willow Court, Totowa N.J. 07512.

WANTED: Transformer for a Weston 777 tube tester, Supreme AAA-1 & 400B Diagnometers, also other early radio test equipment. Don F. Thompson, Route 1, Box 9C, Samoa CA 95564.

WANTED: National SW-3 complete with power supply and coils. Must be mint. WB1BVO, Norman A. Parsons, 22 Forest St., Branford CT 06405.

WANTED: Tuning dial drum or junk chassis containing one, as used in RCA Radiolas 18, 51, 60 etc., also Graybar 330. Please price.
Harbeck, 1316 - 38th St., Sioux City IA 51104.

WANTED: Zenith portable radios, especially suitcase types, pre-Trans-Oceanics. Rosenthal, 507 S. Maryland Ave., Wilmington DE 19804, or (302) 994-0874.

WANTED: 1920 - 1940 RCA and other factory service manuals.
Robert Goodman, 7943 Ponce Ave., Canoga Park CA 91304.

WANTED: Crosley model 50, Crosley 51-A 2 stage amp.
Speaker grill for Radiola 26 a portable, will buy or trade.
Andy Anderson, 151 Nooks Hill Rd. Cormwell CT 06416.

URGENT! I need an RF. XFMR for my LEUTZ C-7! (Drum-shaped and marked C7). Will pay up to $30.
Fred Creed, 219 Hartwood Ave., Waterloo, Ont. Canada N2A 2P1.

WANTED: Kennedy, DeForest and Marconi sets. Trade or buy.
Steve Lange, Waldo WI 53093. (414) 541-4811.

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P.O. BOX 28572 DALLAS TEXAS 75228
PUBLISHERS OF
THE CLASSIC RADIO NEWSLETTER
(send 13¢ stamp for newsletter sample)

LIST NO. 16A

SCHEMATIC DIAGRAMS
WE CAN FURNISH SCHEMATICS ON ANY RADIO (1920 to 1954) - $1.50 postpaid. IF YOU CAN NOT FURNISH THE NAME OF THE MANUFACTURER AND THE MODEL NUMBER, SEND THE TYPES AND QUANTITY OF TUBES AND WE WILL RESEARCH OUR FILES FOR A SIMILAR SET WHICH USES THE SAME TUBES - RESEARCH $3.00 postpaid.

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01A, 99, WD-11, etc. when in stock, ANTIQUE RADIO SETS AND TEST GEAR, ANTIQUE RADIO BOOKS, AND OTHER "one at a time" items-- list sent by first class mail four to six times a year by subscription -- $2.00 per year.

BALLAST TUBES send for catalog.

THE PUETT ELECTRONICS SUPER ANTENNA - GROUND SYSTEM plans $2.

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(1) THE ACQUISITION OF ANTIQUE RADIOS by J. W. F. Puett $2.00
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(3) THE COMPLETE RESTORATION OF AC POWERED ANTIQUE RADIOS by J. W. F. Puett $2.00
(4) COMPLETE LIST OF ANTIQUE RADIO SERVICES $2.00 (new list)
(5) WHEN WAS THAT OLD TUBE MADE? by James R. Wilkins $2.00
(6) SILVER GHOSTS by J. W. F. Puett - classic sets by E. H. Scott $10.00
(7) MILITARY TUBE TYPE (VT) TO COMMERCIAL TUBE TYPE CROSS-REFERENCE LIST $1.00

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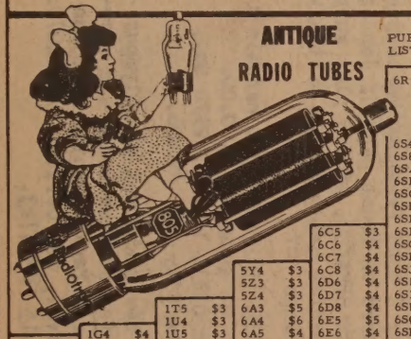
(2) WE SHIP PARCEL POST, NO C. O. D. INCLUDE 15% FOR POSTAGE & HANDLING. POSTAL INSURANCE RATES ARE 60¢ FOR ORDERS UP TO FIFTY DOLLARS. MINIMUM ORDER $3.00 - DOES NOT APPLY TO SCHEMATIC DIAGRAMS OR BOOKLETS. ORDERS WHICH EXCEED $50.00 ARE SHIPPED POSTPAID. TEXAS RESIDENTS ADD 5% STATE SALES TAX.

POLICY

CUSTOMER SATISFACTION GUARANTEED. If you are not satisfied with your order for any reason, tubes may be returned within ten days for refund or replacement with exception of tubes which are shorted or have open filaments. It will be assumed that returned tubes with open filaments or shorts were damaged in shipment. Shipping damage claims will be handled promptly through the post office on insured orders. PUETT ELECTRONICS assumes no liability for orders which are not insured, and no liability beyond that which is covered by postal insurance. The tubes listed herein are either new, military pull-outs, factory over-purchases, or used. If only new tubes in original cartons are acceptable, add 10% to the total cost of your tube order. REFUNDS are mailed with your invoice for out-of-stock merchandise. ALL TUBES ARE THOROUGHLY TESTED ON A MUTUAL CONDUCTANCE TUBE CHECKER BEFORE SHIPMENT. ALL TUBES MUST MEET NEW TUBE STANDARDS WHEN CHECKED. All prices are subject to change without notice. All tube prices listed herein supersede prices in previous lists and ads. We offer free technical advice for a 13¢ stamp or you may call J. W. F. Puett at 214-279-8309 NO LATER THAN 10:00 PM CENTRAL STANDARD TIME - PLEASE.



ANTIQUE RADIO TUBES

PUETT ELECTRONICS HAS HUNDREDS OF OTHER TUBE TYPES NOT LISTED HEREIN. FOR OTHER TUBE TYPES, SEND 65¢ FOR CATALOG.

						6R7	$4	7B5	$3	12K7	$4	25AC5	$3	50C6	$4
								7B6	$4	12K8	$4	25B6	$3	50L6	$3
								7B7	$4	12L6	$2	25C6	$2	50X6	$4
								7B8	$4	12Q7	$4	25L6	$3	50Y7	$4
								7C5	$3	12S8	$3	25S	$4	51	$4
						6S4	$4	7C6	$4	12SA7	$3	25Z5	$3	55	$5
						6S8	$4	7C7	$4	12SC7	$3	25Z6	$3	56	$3
						6SA7	$3	7E6	$4	12SF5	$3	26	$6	57	$4
						6SB7	$3	7E7	$4	12SF7	$3	26A6	$4	58	$4
						6SC7	$3	7F8	$5	12SQ7	$3	26A7	$4	59	$6
						6SD7	$3	7G7	$4	12SH7	$3	27	$4	70A7	$3
						6SF5	$3	7H7	$4	12SJ7	$3	28D7	$3	70L7	$5
						6SF7	$3	7J7	$4	12SK7	$3	30	$5	71A	$7
						6SG7	$4	7L7	$4	12SL7	$3	31	$4	75	$4
						6SH7	$3	7Q7	$4	12SN7	$3	32	$4	76	$3
						6SJ7	$3	7R7	$4	12SQ7	$3	33	$4	77	$4
						6SK7	$3	7S7	$4	12SR7	$3	34	$4	78	$4
						6SL7	$3	7V7	$4	12V6	$3	35	$4	79	$4
						6SN7	$2	7W7	$4	12X4	$2	35A5	$4	80	$3
						6SQ7	$3	7X6	$4	12Z3	$2	35B5	$2	81	$6
						6SR7	$3	7X7	$4	14A4	$4	35C5	$2	82	$3
						6SS7	$3	7Y4	$4	14A5	$4	35L6	$3	83	$3
						6ST7	$3	7Z4	$3	14A7	$4	35W4	$2	83V	$3
						6SU7	$3	10	$7	14B5	$3	35Y4	$4	84	$3
						6SV7	$3	12A5	$4	14B6	$4	35Z3	$4	85	$4
						6T7	$4	12A6	$4	14B8	$4	35Z4	$4	89	$4
						6U5	$5	12A7	$4	14C5	$3	35Z5	$3	117L7	$5
						6U7	$5	12A8	$4	14C7	$4	35Z6	$4	117M7	$5
						6V6	$2	12AH7	$3	14E6	$4	36	$4		
						6X4	$2	12AT6	$2	14E7	$4	37	$4		
						6X5	$2	12AT7	$2	14F7	$4	38	$3		
						6Y5	$3	12AU6	$2	14F8	$4	39	$3		
						6Z4	$3	12AU7	$2	14H7	$4	40	$7		
						6ZY5	$3	12AV6	$2	14J7	$4	41	$4		
						7A4	$4	12AX7	$2	14N7	$4	42	$4		
						7A5	$3	12B7	$4	14Q7	$4	43	$4		
						7A6	$4	12B8	$4	14R7	$4	44	$3		
						7A7	$4	12BA6	$2	14W7	$4	45	$6		
						7A8	$4	12BE6	$2	14X7	$4	47	$7		
						7AE7	$4	12C5	$3	15	$7	48	$4		
						7AG7	$4	12C8	$4	19	$4	49	$4		
						7B4	$4	12F5	$3	22	$7	50	$7		
								12H6	$3	24A	$5	50A5	$3		
								12J5	$3	25A6	$3	50B5	$2		
								12J7	$4	25A7	$3	50C5	$2		

								6C5	$3	6SF7	$3			117N7	$7
								6C6	$4	6SG7	$4			117P7	$7
								6C7	$4	6SH7	$3			117Z3	$3
								6C8	$4	6SJ7	$3			117Z4	$4
								6D6	$4	6SK7	$3			117Z6	$4
								6D7	$4	6SL7	$3			485	$5
								6D8	$4	6SN7	$2			884	$7
								6E6	$4	6SQ7	$3			950	$5
								6E5	$5	6SR7	$3			951	$5
								6E6	$4	6SS7	$3			955	$4
								6E7	$4	6ST7	$3			958	$4
								6F5	$4	6SU7	$3			1201	$4
								6F6	$4	6SV7	$3			1203	$4
								6F7	$6	6T7	$4			1232	$4
								6F8	$4	6U5	$5			1273	$4
								6G5	$5	6U7	$5			1852	$3
								6G6	$3	6V6	$2			1853	$3
								6H6	$2	6X4	$2			9002	$3
								6J5	$3	6X5	$2			9003	$3
								6J8	$4	6Y5	$3			9004	$4
								6K5	$3	6Z4	$3			VR-90	$2
								6K6	$3	6Z5	$3			VR-105	$2
								6K7	$4	6Z7	$2			VR-150	$2
								6K8	$4	6ZY5	$3			VT-52	$5
								6L5	$4	7A4	$4			FM1000	$4
								6L6	$3	7A5	$3			XXB	$4
								6L7	$4	7A6	$4			XXL	$4
								6N5	$5	7A7	$4			XXFM	$4
								6N6	$4	7A8	$4				
								6N7	$4	7AE7	$4				
								6P5	$3	7AG7	$4				
								6Q7	$4	7B4	$4				

						5Y4	$3								
						5Z3	$3								
						5Z4	$3								
		1T5	$3			6A3	$5	6D8	$4	6SN7	$2				
		1U4	$3			6A4	$6	6E5	$5	6SQ7	$3				
		1U5	$3			6A5	$4	6E6	$4	6SR7	$3				
		1V	$5			6A6	$4	6E7	$4	6SS7	$3				
		1G4	$4			6A7	$5	6F5	$4	6ST7	$3				
		1G5	$4			6A8	$4	6F6	$4	6SU7	$3				
		1G6	$4			6AB4	$3	6F7	$6	6SV7	$3				
		1H4	$5			6AB7	$3	6F8	$4	6T7	$4				
		1H6	$4			6AC5	$3	6G5	$5	6U5	$5				
		1J6	$4			6AC7	$3	6G6	$3	6U7	$5				
		1L6	$8			6AK5	$2	6H6	$2	6V6	$2				
		1LA4	$4			6AL5	$3	6J5	$3	6V7	$4				
		1LA6	$4			6AL7	$5	6J6	$2	6X4	$2				
		1LB4	$4			6AQ5	$2	6J7	$4	6X5	$2				
		1LC5	$5			6AT6	$2	6J8	$4	6Y5	$3				
		1LC6	$4			6AU6	$2	6K5	$3	6Z4	$3				
		1LD5	$4			6AV6	$2	6K6	$3	6Z5	$3				
		1LE3	$4			6AX5	$2	6K7	$4	6Z7	$2				
		1LF3	$4			6BA6	$2	6K8	$4	6ZY5	$3				
		1LH4	$4			6BE6	$3	6L5	$4	7A4	$4				
		1LN5	$4			6BJ6	$2	6L6	$3	7A5	$3				
		1N5	$4			6C4	$2	6L7	$4	7A6	$4				
		1N6	$4			6C5	$3	6N5	$5	7A7	$4				
		1P5	$4			6C6	$4	6N6	$4	7A8	$4				
		1Q5	$4			6C7	$4	6N7	$4	7AE7	$4				
		1R5	$2			6C8	$4	6P5	$3	7AG7	$4				
		1S5	$2			6D6	$4	6Q7	$4	7B4	$4				
		1T4	$3			6D7	$4								

QD3	$2														
024	$3														
1A1	$5														
1A3	$4														
1A4	$4														
1A5	$4														
1A6	$3														
1A7	$3														
1B4	$4														
1B5	$4														
1B7	$4														
1B8	$4														
1C1	$4														
1C5	$3														
1C6	$3														
1C7	$5														
1D5	$5														
1D7	$5														
1E5	$5														
1E7	$4														
1F4	$4														
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1F6	$4														
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